

May 1997

Preliminary Data Summary

by Field Research Facility

U.S. Army Corps of Engineers
Waterways Experiment Station
Coastal and Hydraulics Laboratory
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Preface

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

Data from these reports are now available via the World Wide Web at
<http://www.frf.usace.army.mil>

These web pages contain general information about the Field Research Facility and data from 1980 to the present.

Your comments and suggestions are welcome.

Introduction

1

The U.S. Army Corps of Engineers Waterways Experiment Station, Coastal and Hydraulics Laboratory (CHL), Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.75 m above the National Geodetic Vertical Datum (NGVD) of the year 1929.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local bathymetric, oceanographic, and meteorological conditions. This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Clifford F. Baron at (919)261-6840 ext.222 (c.baron@cerc.wes.army.mil).

Chapter 2 presents the meteorological data; Chapters 3 through 6 present oceanographic data; Chapter 7 presents nearshore profiles and bathymetry; and Chapter 8, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used and their operational status during the month. Figure 2 shows weather and ocean conditions for the month. Table 2 and Figure 3 identifies the location of the instruments. The water depths at the wave gauges and current meters vary and may be determined from information contained in Figure 9. Other installation information is contained in Table 2.

Times given in the report are referenced to eastern standard time (EST).

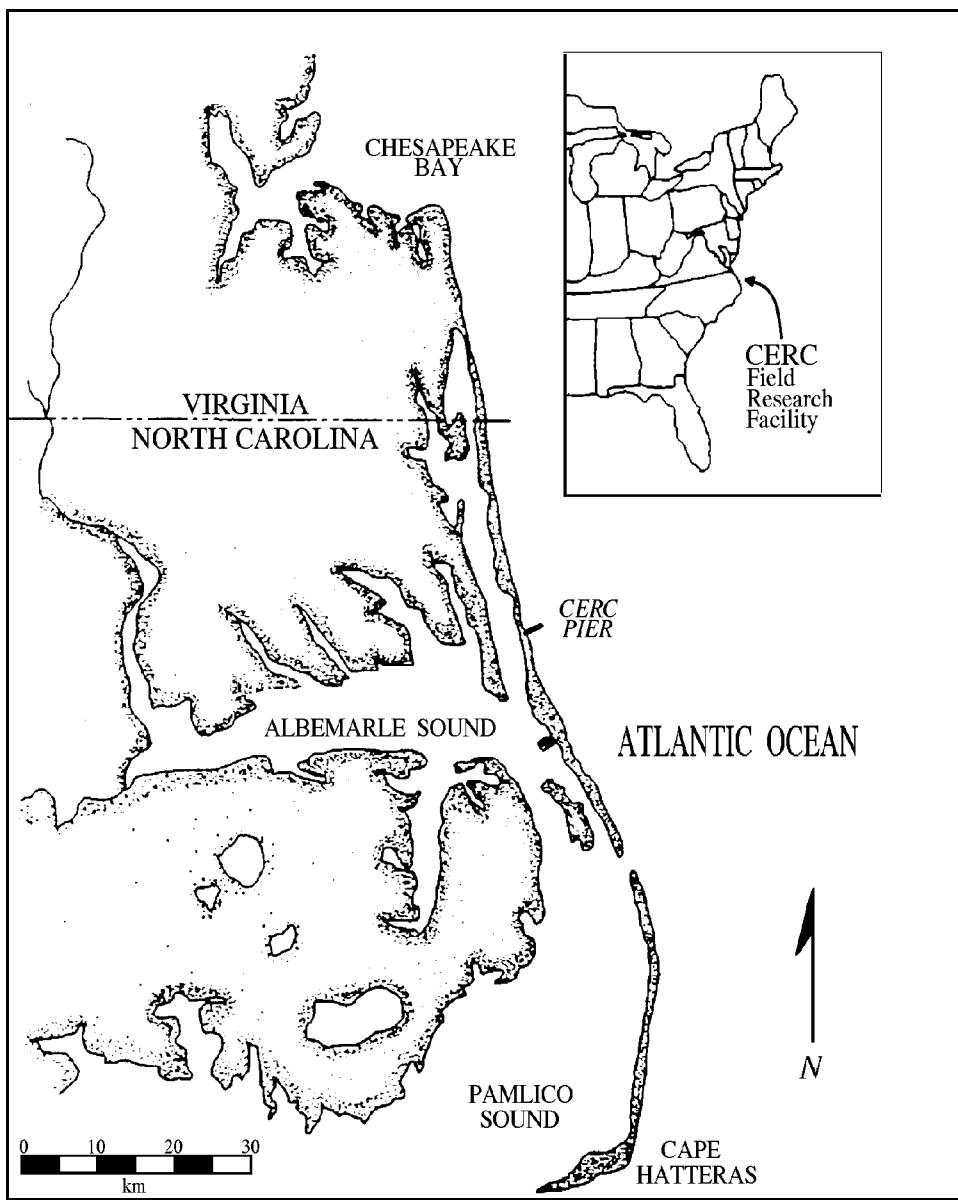


Figure 1. FRF Location Map

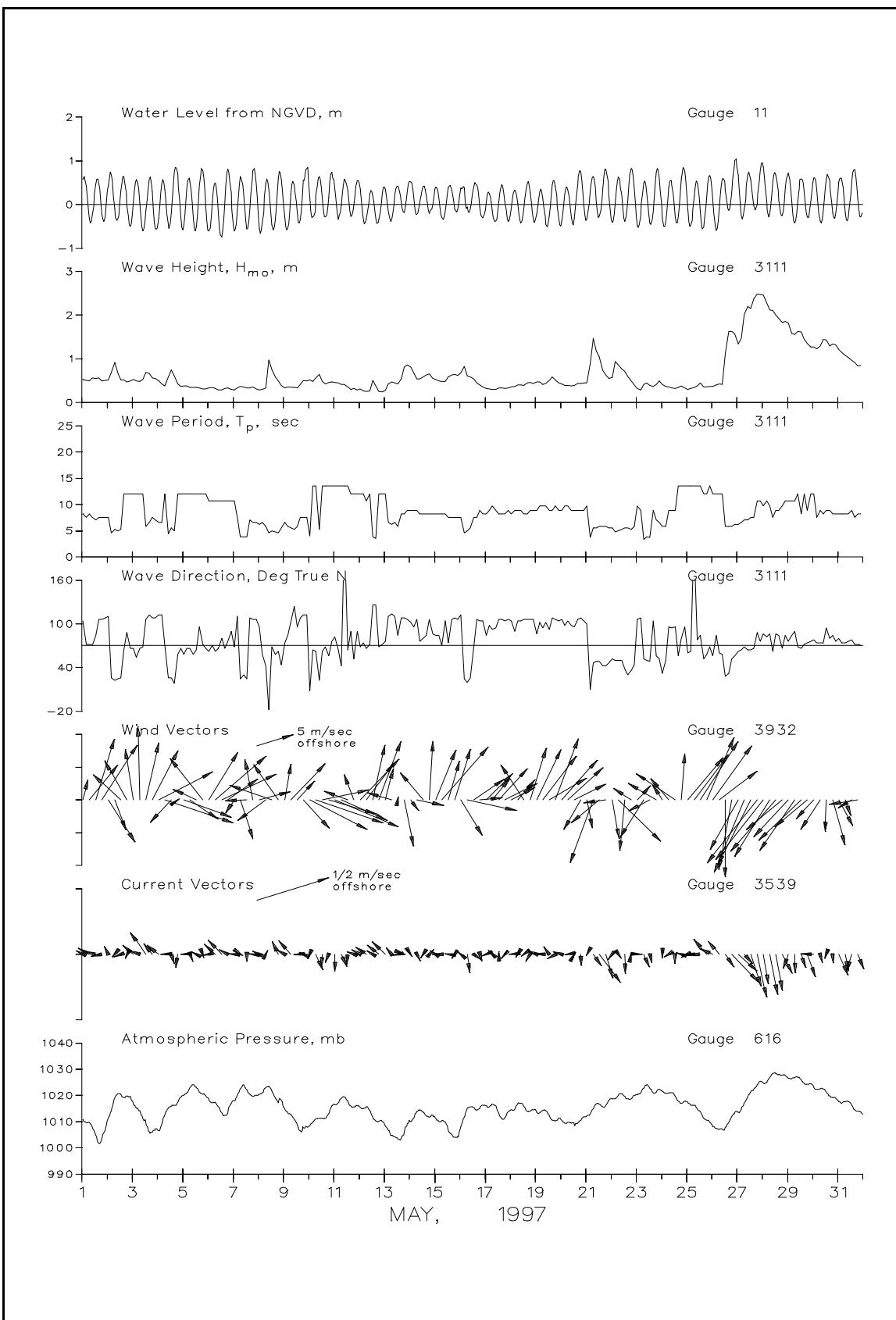


Figure 2. Month at a Glance

Table 1
Instrument Status/Data Availability

		May 1997																															
		Day of the month																															
Gauge ID	Description/Remarks	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	
616	Atmospheric Pressure	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
604	Precipitation	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
624	Air Temperature	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3932	Anemometer	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
641	Pressure Gauge on FRF pier	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
625	Baylor staff on FRF pier	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3111	8 Meter Array 309 m north of FRF	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
131	Pressure Gauge center of 8 Meter Array	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
630	Waiverider buoy 4.0 km offshore	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/ -
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/ -
3539	Current meter 343 m north of FRF pier (1.6 km offshore)	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11	NOAA tide gauge at end of pier	Gauge Status	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		Data Collected	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Visual Observations (daily oceanographic and meteorological observations)		Daily observation	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
Gauge Status * = Operational / = Partial - = Non-Operational																																	
Data Collected * = All / = Partial - = None																																	
Visual Observations * = Complete / = Partial - = None																																	

Table 2
Gauge Locations

Gauge*	Description	* Latitude	* Longitude	* FRF Coordinates	* Gauge Depth	* Water Depth
ID *		* Degrees N	* Degrees W	* CrossshoreT Longshore*	NGVD, m	* NGVD, m
		*	*	*	m	*
616	* Atmospheric Pressure*	36 10' 57.03"	* 75 45' 5.50"	* 11.60	* 569.00	* -----
3932	* Anemometer	* 36 11' 1.23"	* 75 44' 43.07"	* 585.20	* 517.30	* 19.50
641	* Pressure Gauge	* 36 10' 57.71"	* 75 44' 56.23"	* 239.11	* 516.64	* -1.64
625	* Baylor Staff	* 36 11' 1.04"	* 75 44' 43.72"	* 568.00	* 516.64	* Surface
3111	* 8 Meter Array North	* 36 11' 19.14"	* 75 44' 36.41"	* 915.23	* 990.16	* -7.50
	* 8 Meter Array South	* 36 11' 11.28"	* 75 44' 33.28"	* 914.20	* 735.37	* -7.42
	* 8 Meter Array East	* 36 11' 13.70"	* 75 44' 32.56"	* 954.51	* 800.58	* -7.62
	* 8 Meter Array West	* 36 11' 12.48"	* 75 44' 37.11"	* 834.66	* 800.37	* -6.98
131	* Pressure Gauge in center of 8 M Array	* 36 11' 15.66"	* 75 44' 39.84"	* 914.89	* 800.47	* -7.44
630	* Waverider Buoy	* 36 10' 5.10"	* 75 41' 59.30"	* 3934.96	* -2400.81	* Surface
3539	* Current Meter	* 36 11' 23.57"	* 75 44' 9.12"	* 1605.80	* 907.60	* -11.60
11	* NOAA Tide Gauge	* 36 11' 1.25"	* 75 44' 42.60"	* 596.49	* 514.20	* Surface
R	R	R	R	R	R	R

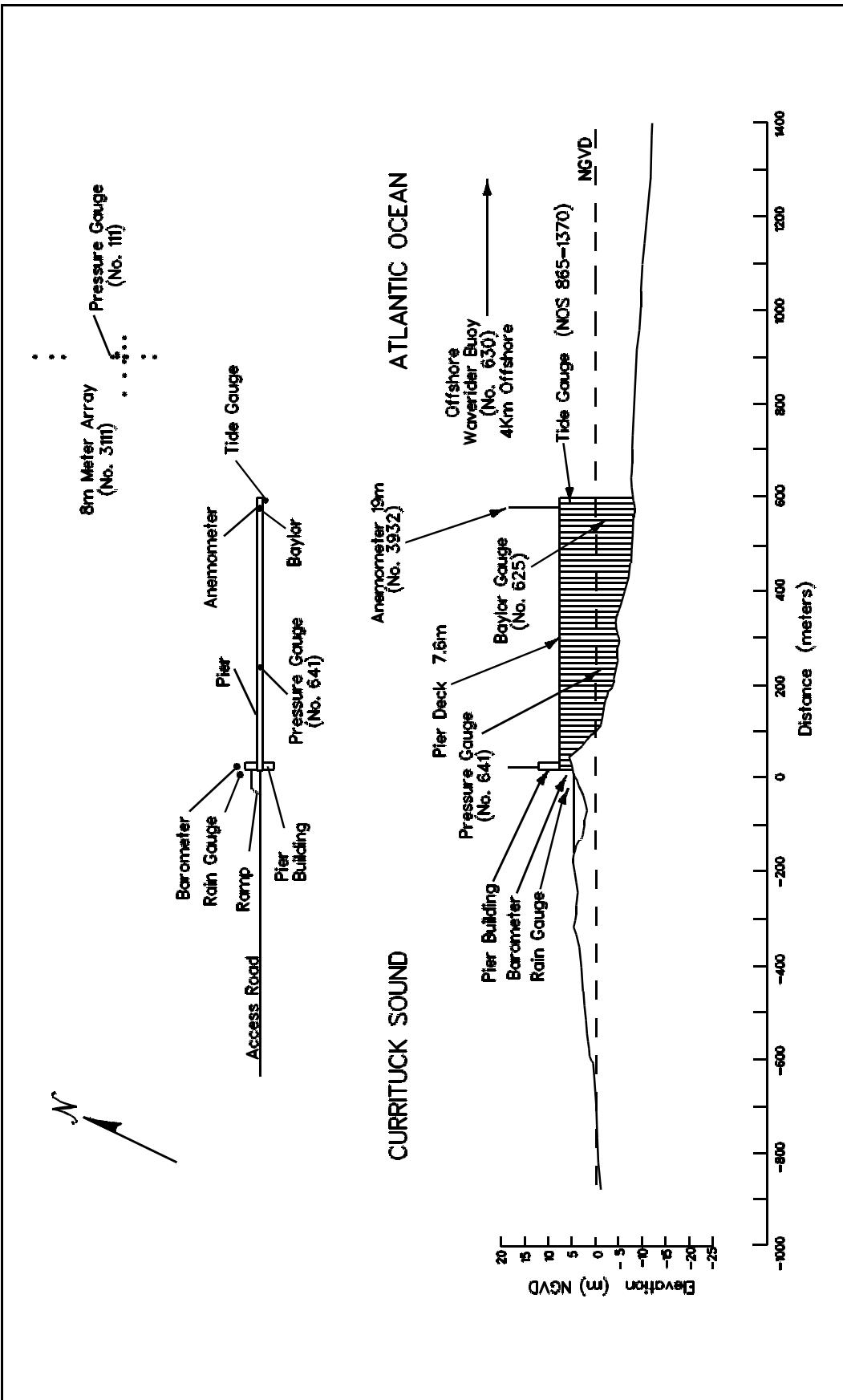


Figure 3. Instrument Locations, Elevations From NGVD

Meteorological Data

2

A variety of instruments have been installed at the FRF (Figure 3) to monitor the meteorological conditions. The data presented in Table 3 are collected and stored using a Digital Equipment Corporation VAXstation 4000. For each instrument identified in Table 1, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m using a WeatherMeasure Skyvane anemometer. Monthly resultant wind speeds and directions (Figure 4) are determined by vector averaging the data. Wind directions (Table 3) indicate where the wind is coming from. Temperature and atmospheric pressure means (Table 3) are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 3 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

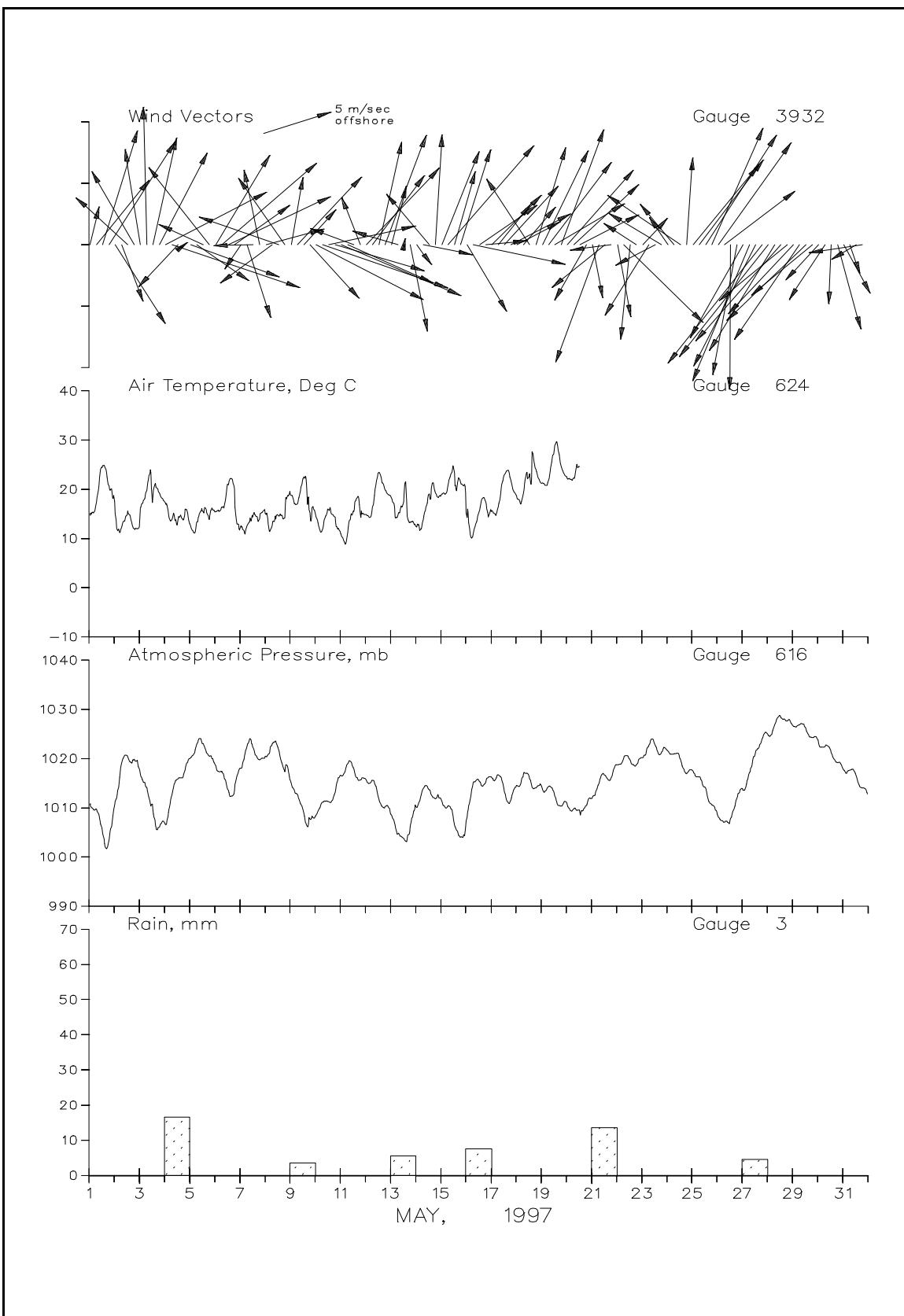


Figure 4. Meteorological Monthly Summary

Table 3
Meteorological Data

May 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	3	191	14.8	1010.8	0
	700	6	215	17.5	1009.8	0
	1300	10	194	24.8	1005.0	0
	1900	10	208	20.7	1003.5	0
2	100	7	331	15.0	1011.3	0
	700	5	341	12.3	1019.2	0
	1300	5	136	15.6	1020.5	0
	1900	7	153	12.0	1019.9	0
3	100	8	172	16.1	1017.0	0
	700	11	178	19.8	1014.2	0
	1300	9	190	18.6	1009.6	0
	1900	8	204	19.2	1006.1	0
4	100	8	238	17.2	1006.7	0
	700	10	291	13.9	1012.7	17
	1300	4	38	13.9	1015.9	0
	1900	0		14.6	1017.4	0
5	100	7	292	12.5	1020.2	0
	700	5	308	13.4	1022.9	0
	1300	3	118	15.5	1023.1	0
	1900	8	145	13.8	1020.5	0
6	100	8	207	15.5	1018.6	0
	700	9	225	16.4	1017.4	0
	1300	8	241	21.0	1013.5	0
	1900	5	230	20.1	1013.5	0
7	100	2	29	12.7	1018.1	0
	700	6	1	12.6	1022.6	0
	1300	3	88	14.8	1022.3	0
	1900	6	169	14.1	1019.8	0
8	100	4	252	14.9	1020.4	0
	700	5	49	12.7	1023.0	0
	1300	6	112	14.5	1021.8	0
	1900	6	149	14.1	1017.3	0
9	100	6	188	18.7	1014.9	0
	700	7	219	17.0	1012.8	4
	1300	4	218	22.6	1008.9	0
	1900	6	321	15.2	1007.8	0
10	100	9	300	14.3	1008.6	0
	700	9	291	11.9	1011.2	0
	1300	6	256	15.9	1011.3	0
	1900	7	1	14.3	1013.1	0

Table 3
Meteorological Data (continued)

May 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
11	100	9	296	10.6	1016.5	0
	700	7	1	11.3	1019.0	0
	1300	3	113	15.5	1018.0	0
	1900	4	161	14.8	1015.7	0
12	100	8	219	14.9	1015.5	0
	700	7	212	16.4	1015.6	0
	1300	9	190	23.5	1011.8	0
	1900	9	197	19.9	1010.3	0
13	100	5	192	18.2	1008.6	0
	700	3	108	14.9	1004.8	5
	1300	1	189	19.4	1003.6	0
	1900	7	350	13.2	1006.3	0
14	100	2	327	12.3	1010.1	0
	700	4	1	13.9	1014.0	0
	1300	5	143	19.1	1013.7	0
	1900	9	183	19.3	1011.8	0
15	100	8	199	19.1	1011.3	0
	700	10	216	20.9	1010.4	0
	1300	6	193	23.4	1006.5	0
	1900	8	195	21.4	1004.0	0
16	100	6	332	14.3	1008.2	0
	700	7	283	10.9	1015.1	7
	1300	5	231	15.8	1015.3	0
	1900	3	1	17.4	1015.2	0
17	100	5	220	15.6	1016.1	0
	700	4	214	16.5	1016.8	0
	1300	6	218	23.0	1013.2	0
	1900	5	239	21.8	1011.6	0
18	100	4	238	18.3	1014.6	0
	700	4	216	19.3	1017.0	0
	1300	6	150	23.1	1016.0	0
	1900	8	194	24.0	1014.1	0
19	100	8	202	21.3	1013.7	0
	700	8	213	21.9	1014.4	0
	1300	6	235	28.9	1012.5	0
	1900	10	197	24.6	1010.4	0
20	100	8	217	22.1	1010.6	0
	700	7	223	22.3	1009.8	0
	1300	5	239		1009.0	0
	1900	5	26	inoperative	1010.5	0

Table 3
Meteorological Data (concluded)

May 1997						
Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
21	100	4	350		1012.2	0
	700	10	17	inoperative	1015.0	13
	1300	5	47		1016.7	0
	1900	3	81		1016.2	0
22	100	6	1		1018.8	0
	700	8	1		1020.2	0
	1300	8	4		1019.7	0
	1900	3	127		1018.8	0
23	100	3	218		1020.3	0
	700	6	28		1022.8	0
	1300	3	58		1022.7	0
	1900	4	124		1021.4	0
24	100	3	149		1021.6	0
	700	4	144		1021.0	0
	1300	7	128		1019.8	0
	1900	7	183		1017.0	0
25	100	8	215		1017.4	0
	700	8	213		1016.4	0
	1300	10	209		1013.9	0
	1900	10	200		1010.6	0
26	100	10	211	inoperative	1008.2	0
	700	7	228		1007.1	0
	1300	12	1		1007.8	0
	1900	11	9		1012.1	0
27	100	8	26		1013.6	0
	700	12	19		1017.2	5
	1300	11	23		1021.4	0
	1900	12	34		1024.1	0
28	100	11	34		1024.7	0
	700	10	27		1026.9	0
	1300	10	37		1028.3	0
	1900	7	46		1027.7	0
29	100	7	39		1026.6	0
	700	9	30		1026.9	0
	1300	8	42		1026.0	0
	1900	6	46		1024.3	0
30	100	4	38	inoperative	1023.2	0
	700	5	29		1022.5	0
	1300	5	1		1021.2	0
	1900	7	346		1019.2	0
31	100	4	334		1017.7	0
	700	2	343		1017.6	0
	1300	2	55		1016.4	0
	1900	4	80		1014.0	0
		Resultant		Mean	Mean	Total
		1	215	17.1	1015.6	51

Wave Data

3

Wave data are collected from three different sets of instruments, as shown in Table 1 and Figure 3. The first is an array of fifteen pressure gauges, collectively referred to as gauge 3111 (gauge 111 being one of them). Directional information is computed from these gauges using an iterative maximum likelihood estimator. The second is a Baylor staff gauge (625) and a pressure gauge (641), both attached to the pier. The third is a Waverider buoy (630). The data are collected, analyzed, and stored on optical disc using a Digital Equipment Corporation VAXstation 4000. Data is sampled at 2 hertz, with five contiguous 34 minute records, for a total collection period of nearly 2 hours and 51 minutes. This report reflects the data collection periods of 0100, 0700, 1300, and 1900 EST. The results are based only on the first 34 minute record. The exception is the 8 Meter Array (3111) which condenses the first four records into one statistical value.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gauge has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 degrees of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum.

Table 4 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 4 are average values computed from this data. Figure 5 is a time history of all H_{mo} and T_p values obtained for all gauges.

Differences in wave periods between wave gauges (Table 4 and Figure 5) may be the result of wave breaking, wave reformation, the presence of multiple wave trains containing nearly equal energy, and statistical variations in spectral estimations.

Table 4
Wave Data

May 1997											
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider		
		Hmo,m	Tp,sec	Hmo,m	Tp,sec	Hmo,m	Tp,sec	Dir,TN	Hmo,m	Tp,sec	
1	0100	0.28	8.1	0.51	8.1	0.53	8.2	104	0.62	7.7	
	0700	0.17	8.1	0.41	8.1	0.50	8.2	72	0.58	7.2	
	1300	0.28	7.2	0.55	7.6	0.55	7.1	84	0.77	7.7	
	1900	0.28	7.4	0.52	7.6	0.50	7.6	106	0.93	4.4	
2	0100	0.26	7.0	0.49	7.6	0.51	7.6	110	inoperative		
	0700	0.81	5.3	0.97	5.4	0.92	5.3	22	1.27	5.0	
	1300	0.41	5.3	0.60	5.1	0.52	5.3	26	0.71	5.1	
	1900	0.31	5.2	0.50	12.9	0.47	12.0	88	0.72	11.8	
3	0100	0.25	6.1	0.47	6.5	0.52	12.0	66	0.61	6.3	
	0700	0.27	12.2	0.48	12.2	0.49	12.0	66	0.70	11.2	
	1300	0.42	5.7	0.62	5.9	0.69	5.9	106	0.98	5.3	
	1900	0.38	7.2	0.57	7.2	0.57	7.6	108	0.83	7.2	
4	0100	0.29	6.5	0.48	7.0	0.50	6.6	112	0.78	6.3	
	0700	0.25	12.2	0.47	11.7	0.38	12.0	70	0.71	3.6	
	1300	0.64	5.7	0.73	5.9	0.75	5.6	26	0.88	4.6	
	1900	0.32	5.4	0.46	5.2	0.43	12.0	58	0.62	5.3	
5	0100	0.19	4.9	0.38	12.2	0.38	12.0	58	0.51	11.8	
	0700	0.20	12.2	0.36	10.7	0.34	12.0	66	0.40	11.2	
	1300	0.15	11.7	0.31	10.7	0.34	12.0	64	0.39	11.8	
	1900	0.25	12.2	0.46	11.7	0.32	12.0	72	0.52	11.8	
6	0100	0.14	11.7	0.37	10.7	0.34	10.8	62	0.58	11.8	
	0700	0.18	11.2	0.30	11.2	0.32	10.8	62	0.55	11.2	
	1300	0.11	6.5	0.24	11.2	0.29	10.8	80	0.47	10.6	
	1900	0.22	6.8	0.36	3.8	0.34	10.8	76	0.49	5.9	
7	0100	0.16	3.0	0.33	9.9	0.29	10.8	68	0.44	10.6	
	0700	0.32	3.7	0.54	3.6	0.37	3.9	24	0.67	3.6	
	1300	0.28	4.1	0.44	3.9	0.34	3.9	24	0.50	3.9	
	1900	0.27	4.8	0.42	7.2	0.35	6.6	106	0.56	7.2	
8	0100	0.15	4.9	0.32	6.0	0.29	6.2	96	0.45	6.3	
	0700	0.30	3.3	0.51	3.3	0.33	5.9	42	0.56	3.1	
	1300	0.40	4.6	0.78	5.0	0.76	5.0	68	0.93	4.8	
	1900	0.29	5.7	0.55	4.8	0.50	4.6	62	0.63	4.4	
9	0100	0.18	5.2	0.39	5.6	0.34	6.6	74	0.51	5.6	
	0700	0.18	5.4	0.31	6.1	0.35	5.8	0	0.47	5.1	
	1300	0.17	6.3	0.32	5.4	0.33	5.9	96	0.37	5.9	
	1900	0.34	8.9	0.55	8.9	0.51	7.6	112	0.87	7.7	
10	0100	0.29	4.2	0.50	14.3	0.52	4.1	8	0.86	4.4	
	0700	0.30	15.1	0.49	15.1	0.57	13.6	62	0.75	4.2	
	1300	0.36	5.0	0.47	14.3	0.49	13.6	62	0.77	5.1	
	1900	0.26	13.5	0.36	13.5	0.46	13.6	56	0.63	14.3	

Table 4
Wave Data (continued)

May 1997											
Day	Hour	641		625		3111			630		
		Pressure Hmo,m	Gauge Tp,sec	Baylor Hmo,m	Gauge Tp,sec	8 Meter Hmo,m	Array Tp,sec	Dir,TN	Waverider Hmo,m	Tp,sec	
11	0100	0.34	5.6	0.43	13.5	0.46	13.6	82	0.70	4.8	
	0700	0.32	5.3	0.40	12.9	0.41	13.6	42	0.58	5.3	
	1300	0.27	5.7	0.33	12.2	0.35	13.6	64	0.50	5.3	
	1900	0.19	12.9	0.34	12.9	0.32	12.0	52	0.42	12.6	
12	0100	0.17	12.2	0.28	12.9	0.31	12.0	68	0.51	3.9	
	0700	0.12	12.9	0.23	10.7	0.25	10.8	66	0.36	11.8	
	1300	0.22	3.9	0.36	3.7	0.51	3.9	126	0.58	3.4	
	1900	0.15	15.1	0.25	3.7	0.26	12.0	68	0.56	3.2	
13	0100	0.16	13.5	0.24	9.9	0.28	12.0	76	0.37	11.8	
	0700	0.26	6.3	0.47	6.6	0.47	6.2	114	0.60	6.3	
	1300	0.25	6.5	0.42	6.3	0.42	5.9	84	0.52	6.3	
	1900	0.42	8.3	0.75	8.3	0.81	8.2	108	0.99	8.4	
14	0100	0.52	9.2	0.90	9.2	0.82	8.9	102	1.09	8.4	
	0700	0.25	8.9	0.51	8.9	0.54	8.9	106	0.69	9.1	
	1300	0.27	8.1	0.46	8.3	1.45	3.1	58	0.55	7.7	
	1900	0.32	7.8	0.75	8.3	0.66	8.2	106	0.92	8.4	
15	0100	0.29	8.6	0.54	8.6	0.53	8.2	84	0.71	7.7	
	0700	0.21	8.1	0.47	8.6	0.49	8.2	70	0.70	9.1	
	1300	0.31	8.1	0.53	7.8	0.59	7.6	74	0.57	7.7	
	1900	0.31	7.6	0.61	8.1	0.64	7.6	108	0.67	6.7	
16	0100	0.39	7.4	0.64	7.6	0.68	7.6	112	0.83	7.7	
	0700	0.41	4.9	0.59	4.7	0.61	5.0	20	0.92	4.6	
	1300	0.38	5.4	0.51	8.3	0.54	7.6	68	0.72	5.6	
	1900	0.23	6.6	0.37	8.1	0.40	8.9	104	0.53	9.1	
17	0100	0.18	8.1	0.31	7.4	0.32	8.2	84	0.41	8.4	
	0700	0.14	9.2	0.30	7.8	0.30	9.8	92	0.34	8.4	
	1300	0.18	8.3	0.32	8.3	0.33	8.2	106	0.39	9.1	
	1900	0.19	9.2	0.34	8.3	0.32	8.2	104	0.43	7.7	
18	0100	0.19	9.2	0.33	8.9	0.35	8.2	104	0.43	8.4	
	0700	0.21	9.2	0.38	9.5	0.40	8.9	104	0.45	9.1	
	1300	0.23	8.6	0.43	9.2	0.40	8.2	106	0.50	9.1	
	1900	0.26	8.6	0.45	8.6	0.46	8.9	106	0.63	8.4	
19	0100	0.25	8.9	0.44	9.2	0.48	8.9	86	0.66	10.1	
	0700	0.25	9.5	0.43	9.2	0.41	9.8	94	0.62	10.1	
	1300	0.25	9.2	0.43	9.2	0.50	8.9	92	0.54	9.1	
	1900	0.33	9.5	0.48	9.2	0.52	9.8	106	0.85	9.1	
20	0100	0.21	9.2	0.41	9.5	0.42	8.9	106	0.64	9.1	
	0700	0.25	9.5	0.40	9.5	0.39	9.8	104	0.58	9.1	
	1300	0.19	9.2	0.38	9.5	0.39	8.9	96	0.51	9.1	
	1900	0.32	9.2	0.44	8.9	0.44	8.9	108	0.57	9.1	

Table 4
Wave Data (concluded)

May 1997										
Day	Hour	641 Pressure Gauge		625 Baylor Gauge		3111 8 Meter Array			630 Waverider	
		Hmo, m	Tp, sec	Hmo, m	Tp, sec	Hmo, m	Tp, sec	Dir, TN	Hmo, m	Tp, sec
21	0100	0.24	9.2	0.47	9.2	0.45	9.8	100	0.58	9.1
	0700	1.21	5.3	1.34	5.2	1.47	5.6	46	1.41	4.8
	1300	0.77	5.7	0.98	5.7	1.04	5.9	48	1.25	5.9
	1900	0.51	6.0	0.61	5.7	0.63	5.9	42	0.94	5.6
22	0100	0.33	5.5	0.47	5.3	0.58	5.6	52	0.58	10.1
	0700	0.63	5.0	0.70	4.7	0.94	4.8	0	1.11	4.8
	1300	0.62	5.4	0.71	5.5	0.71	5.6	38	1.03	5.3
	1900	0.42	5.7	0.51	6.0	0.50	5.3	36	0.61	5.6
23	0100	0.19	5.3	0.33	9.2	0.32	9.8	106	0.43	5.3
	0700	0.25	5.1	0.38	9.2	0.42	3.4	52	0.44	9.1
	1300	0.26	3.9	0.44	4.0	0.39	3.8	48	0.47	3.9
	1900	0.30	5.0	0.42	4.4	0.42	7.1	56	0.49	8.4
24	0100	0.26	6.1	0.44	5.9	0.42	5.9	32	0.62	6.3
	0700	0.22	5.2	0.40	6.1	0.35	8.9	96	0.44	8.4
	1300	0.17	8.9	0.36	9.2	0.32	8.9	96	0.45	9.1
	1900	0.21	8.9	0.37	8.6	0.38	13.6	80	0.53	9.1
25	0100	0.14	13.5	0.31	13.5	0.30	13.6	60	0.49	13.4
	0700	0.17	12.9	0.27	13.5	0.34	13.6	222	0.45	13.3
	1300	0.24	4.8	0.45	13.5	0.45	13.6	84	inoperative	
	1900	0.22	12.9	0.31	12.9	0.36	12.0	58	0.62	5.9
26	0100	0.21	13.5	0.34	13.5	0.37	12.0	56	0.65	7.7
	0700	0.23	7.2	0.40	9.2	0.43	12.0	60	0.55	12.6
	1300	0.41	3.4	0.71	3.4	1.12	5.9	28	0.62	7.7
	1900	1.24	5.9	1.53	5.6	1.63	5.9	52	1.97	5.9
27	0100	0.99	6.0	1.27	6.1	1.35	6.2	62	1.60	6.3
	0700	0.93	6.0	1.72	6.3	2.01	7.1	68	1.97	6.7
	1300	1.18	7.4	1.89	7.4	2.15	7.6	64	2.29	7.2
	1900	1.18	9.9	2.20	9.9	2.49	10.8	88	2.66	10.1
28	0100	1.40	9.9	2.23	10.7	2.46	9.8	86	2.73	10.1
	0700	1.17	8.1	1.89	10.3	2.12	9.8	86	2.30	10.6
	1300	1.18	8.1	1.90	10.3	2.00	8.9	86	2.25	8.4
	1900	1.08	10.3	1.66	10.7	1.84	9.8	66	2.13	10.6
29	0100	1.07	11.2	1.72	10.7	1.82	10.8	76	1.92	11.8
	0700	0.81	10.7	1.46	10.3	1.56	10.8	90	1.77	10.1
	1300	0.89	12.9	1.54	12.9	1.61	8.2	66	1.91	12.6
	1900	0.68	12.9	1.31	12.9	1.36	8.9	74	1.53	11.2
30	0100	0.69	11.7	1.25	12.2	1.27	12.0	78	1.48	5.9
	0700	0.52	12.9	1.09	9.2	1.29	8.9	74	1.29	8.4
	1300	0.64	9.2	1.30	8.3	1.43	8.9	94		
	1900	0.61	8.3	1.16	8.6	1.34	8.2	84		
31	0100	0.60	8.1	1.15	8.3	1.21	8.2	80		
	0700	0.45	7.8	0.91	7.8	1.08	8.2	74	inoperative	
	1300	0.44	8.1	0.93	8.1	0.97	8.9	78		
	1900	0.32	8.3	0.83	8.1	0.83	8.2	72		
Mean		0.39	8.0	0.64	8.6	0.68	8.7	75	0.81	7.8
Std dev		0.29	2.9	0.44	2.8	0.50	2.7	29	0.51	2.7

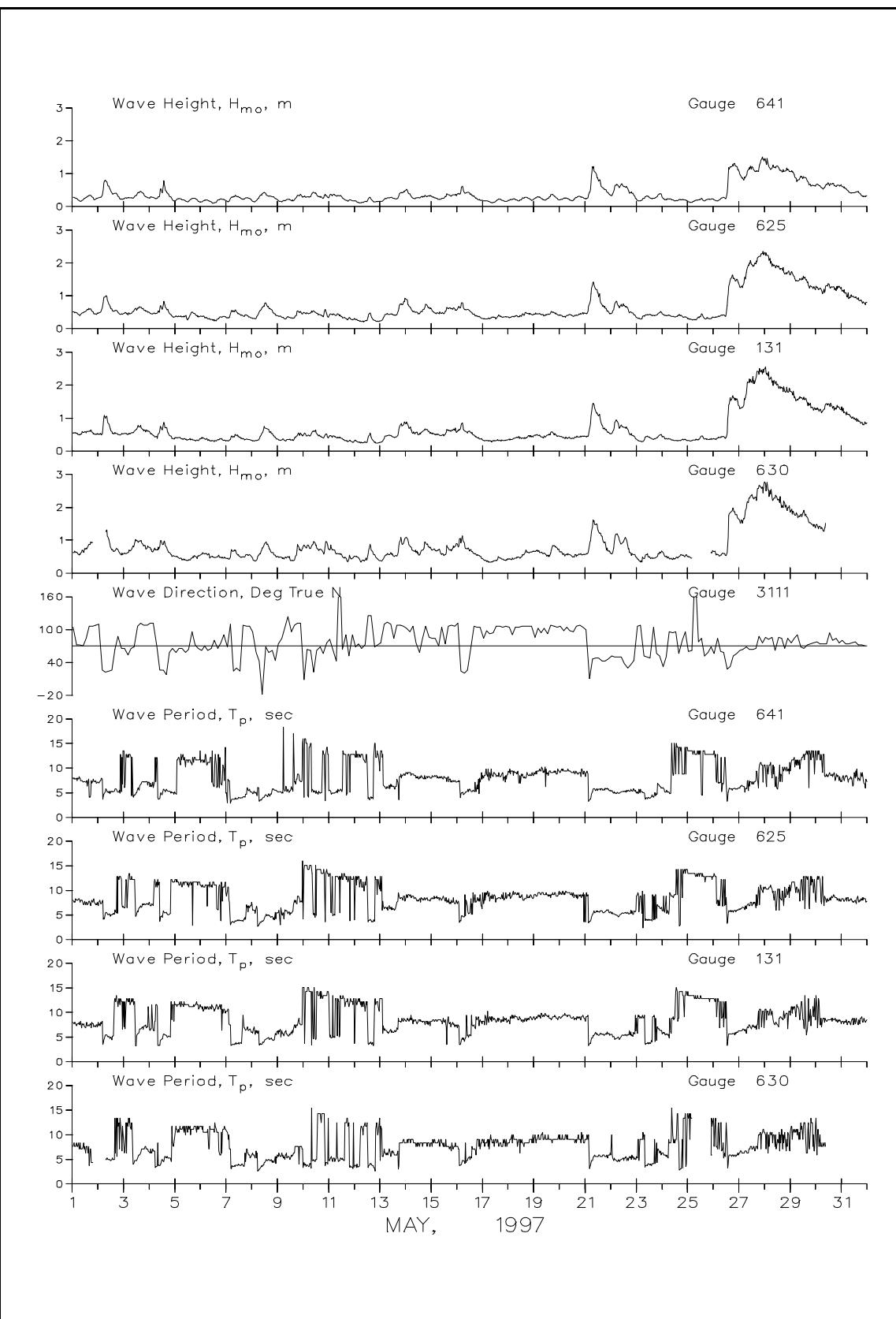


Figure 5. Wave Heights and Periods

Current Data

4

Current data (Table 5) are collected from a Marsh-McBirney electromagnetic biaxial current meter and by visually observing the movement of small drogues on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier, approximately 12 m offshore (Table 6).

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward). All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the cross-shore and longshore data. Current directions indicate the direction that the current is moving towards. Current data are plotted in Figure 2.

Table 5
Current Meter Data - Gauge 3539

MAY 1997																	
	Cross Long				Cross Long				Cross Long								
Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir	Day	Time	Shore	Shore	Speed	Dir
1	100	3	-3	5	300	1300	3	7	8	183	22	100	4	3	5	213	
	700	5	-6	9	301	1900	4	-2	5	292		700	0	4	4	149	
	1300	6	-4	8	287	12 100	4	-4	6	301		1300	5	14	14	178	
	1900	7	0	7	257	700	5	-7	9	307		1900	0	0	0		
2	100	0	-6	7	337	1300	3	-3	5	304	23	100	-2	1	3	94	
	700	2	1	2	217	1900	5	-8	11	312		700	0	10	10	159	
	1300	5	0	5	248	13 100	5	-11	13	317		1300	1	7	7	170	
3	100	4	-8	10	314	1300	4	0	4	258	24	100	1	3	3	182	
	700	5	-4	7	291	1900	0	0	0			700	4	1	4	235	
	1300	4	-18	20	328	14 100	0	2	2	150		1300	3	6	7	182	
	1900	3	-8	10	325	700	0	5	6	157		1900	3	-1	4	291	
4	100	5	-8	10	312	1300	2	2	3	210	25	100	5	1	5	240	
	700	3	0	3	266	1900	-3	-2	5	39		700	6	-1	7	267	
	1300	1	8	8	164	15 100	2	-3	4	308		1300	8	-1	8	264	
	1900	5	9	10	187	700	6	-1	6	269		1900	4	-13	14	324	
5	100	2	0	2	266	1300	2	0	2	279	26	100	7	-6	10	296	
	700	0	6	6	160	1900	3	2	4	213		700	3	-11	13	324	
	1300	2	-2	4	301	16 100	1	-2	3	315		1300	-1	11	11	151	
	1900	0	3	3	162	700	3	14	14	173		1900	-8	26	27	140	
6	100	4	0	4	258	1300	-2	6	7	131	27	100	-6	16	18	136	
	700	4	-9	10	317	1900	1	5	5	167		700	-2	8	9	143	
	1300	5	-12	14	320	17 100	3	0	3	246		1300	2	25	25	164	
	1900	4	-4	7	302	700	2	-3	4	316		1900	5	33	33	169	
7	100	3	-1	3	278	1300	0	-1	2	357	28	100	5	22	23	171	
	700	0	1	2	131	1900	3	2	4	217		700	6	30	31	170	
	1300	2	5	5	179	18 100	1	0	1	263		1300	5	27	28	171	
	1900	3	0	3	279	700	2	2	3	208		1900	0	16	16	155	
8	100	3	-3	5	298	1300	2	1	2	228	29	100	7	9	11	198	
	700	-1	-1	3	26	1900	5	4	6	208		700	5	13	14	179	
	1300	inoperative				19 100	4	-3	6	295		1300	1	10	11	164	
	1900	1	-9	10	337	700	5	-1	6	273		1900	1	18	18	163	
9	100	4	-4	6	304	1300	1	-6	7	329	30	100	8	-2	9	273	
	700	4	-11	13	322	1900	6	2	7	236		700	1	6	6	165	
	1300	2	0	2	264	20 100	5	-3	6	288		1300	2	3	3	197	
	1900	2	-1	3	297	700	2	0	2	258		1900	2	6	7	177	
10	100	2	3	4	198	1300	0	0	0		31	100	0	17	17	159	
	700	0	13	13	159	1900	3	8	9	178		700	2	12	13	170	
	1300	4	9	10	184	21 100	1	1	1	205		1300	7	11	13	193	
	1900	4	5	6	200	700	-1	10	10	149		1900	0	12	12	161	
11	100	5	13	13	180	1300	-5	25	26	147							
	700	0	10	10	158	1900	2	19	19	166							

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Table 6
Visually Observed Current Data

May 1997												
Day	Pier End				Mid-Surf Zone				Beach			
	Cross Shore	Long Shore	Speed	Dir	Cross Shore	Long Shore	Speed	Dir	Location	Speed	Dir	
1	30	-24	39	31	17	-55	58	357	South	46	N	
2	-5	20	20	174	0	76	76	160	South	35	S	
3	-11	-55	57	329	-5	-51	51	334	no observation			
4	0	32	32	160	3	9	10	141	North	9	S	
5	-3	27	27	166	-2	16	16	169	North	15	S	
6	19	-28	34	15	7	-13	15	7	North	15	N	
7	-13	25	28	187	2	22	22	154	North	35	S	
8	-5	14	14	250	-2	5	6	182	North	21	S	
9	10	-6	11	40	12	8	15	70	North	14	N	
10	16	47	50	141	13	44	45	143	North	24	S	
11	0	61	61	160	2	32	32	157	North	17	S	
12	13	-32	35	2	7	-18	20	2	no observation			
13	2	-16	16	346	5	-47	47	346	South	30	N	
14	3	6	7	129	-10	-38	39	326	South	14	N	
15	12	-28	30	4	13	-51	52	354	South	11	N	
16	14	32	35	136	16	27	31	129	North	8	S	
17	5	30	31	151	-6	-20	21	323	South	21	N	
18	3	-5	6	11	-7	-36	37	329	South	15	N	
19	12	-28	30	4	8	-76	77	346	South	30	N	
20	10	-17	20	11	-6	-61	61	334	South	20	N	
21	-18	41	45	184	-15	102	103	169	North	61	N	
22	3	68	68	157	6	55	56	154	North	56	S	
23	-15	51	53	177	-2	36	36	163	North	24	S	
24	6	-8	10	17	2	-16	16	349	South	14	N	
25	18	-41	45	4	9	-29	30	357	South	24	N	
26	10	-10	13	25	10	-51	52	351	South	12	N	
27	-13	44	45	177	-20	68	71	177	North	30	S	
28	-12	20	24	191	-7	23	24	177	North	34	N	
29	-18	30	36	191	8	-27	28	357	South	25	N	
30	-3	28	28	166	-5	23	23	171	North	36	N	
31	-3	30	31	166	-6	-38	39	331	South	18	N	

KEY:

- +cross-shore = offshore, cm/sec
- cross-shore = onshore, cm/sec
- +longshore = south, cm/sec
- longshore = north, cm/sec
- Speed = Resultant speed, cm/sec
- Dir = Resultant direction, degrees true north

Visual Observations

5

Visual wave direction measurements (Table 7) of both the primary wave train (i.e. that having the higher wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The pier axis (considered perpendicular to the beach at the FRF) is oriented 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and depth of visibility are also taken daily at the seaward end of the pier. A Bucket Thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The temperature is then read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the depth of visibility.

Table 7
Visual Observations

May 1997

Day	Time	Wave Approach Angle at Pier End deg from True N		Width of Surf Zone,m	Water Characteristics at Pier End		
		Primary	Secondary		Temp.,C	Density g/cc	Secchi Vis.,m
1	0758	90	130	74	12.2	1.0234	1.2
2	0742	35		126	11.7	1.0247	2.1
3	1106	120		80	11.7	1.0247	0.9
4	1030	35		81	11.9	1.0252	0.9
5	0721	70		42	11.4	1.0251	1.5
6	0753	130		47	11.7	1.0251	1.5
7	0720	25		12	11.7	1.0254	2.4
8	0720	30		42	11.7	1.0252	2.4
9	0855	110		7	12.8	1.0250	1.5
10	0939	30		14	13.3	1.0254	2.1
11	0715	25		26	13.6	1.0222	2.4
12	1053	130		12	13.9	1.0244	2.4
13	0744	110		52	13.3	1.0252	3.7
14	0609	90		65	13.9	1.0248	3.0
15	0648	115		54	12.8	1.0254	1.8
16	0643	15		58	12.2	1.0262	2.1
17	0820	110		38	14.4	1.0230	2.4
18	0626	120		38	15.0	1.0236	3.0
19	0645	125		32	13.9	1.0258	2.1
20	0605	120		33	15.0	1.0262	2.1
21	0605	20		52	16.1	1.0252	3.7
22	0608	10		38	16.7	1.0205	2.1
23	0609	10		24	15.6	1.0211	2.1
24	0820	120		21	16.7	1.0210	3.0
25	0932	125		4	16.1	1.0244	3.4
26	0720	125		35	16.7	1.0258	2.7
27	0606	70		106	15.6	1.0254	1.8
28	0606	65		287	14.4	1.0234	1.8
29	0606	80		221	15.6	1.0219	1.8
30	0613	75		183	16.1	1.0214	1.8
31	0737	90		183	16.7	1.0215	1.8

Water Levels

6

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A NOS acoustic tide gauge (Next Generation Water Level Measurement System, NGWLMS) is used to collect water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 6 along with a list of means and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level. Table 8 contains the range, high, low, and mean water level for each 12.42-hr tidal cycle.

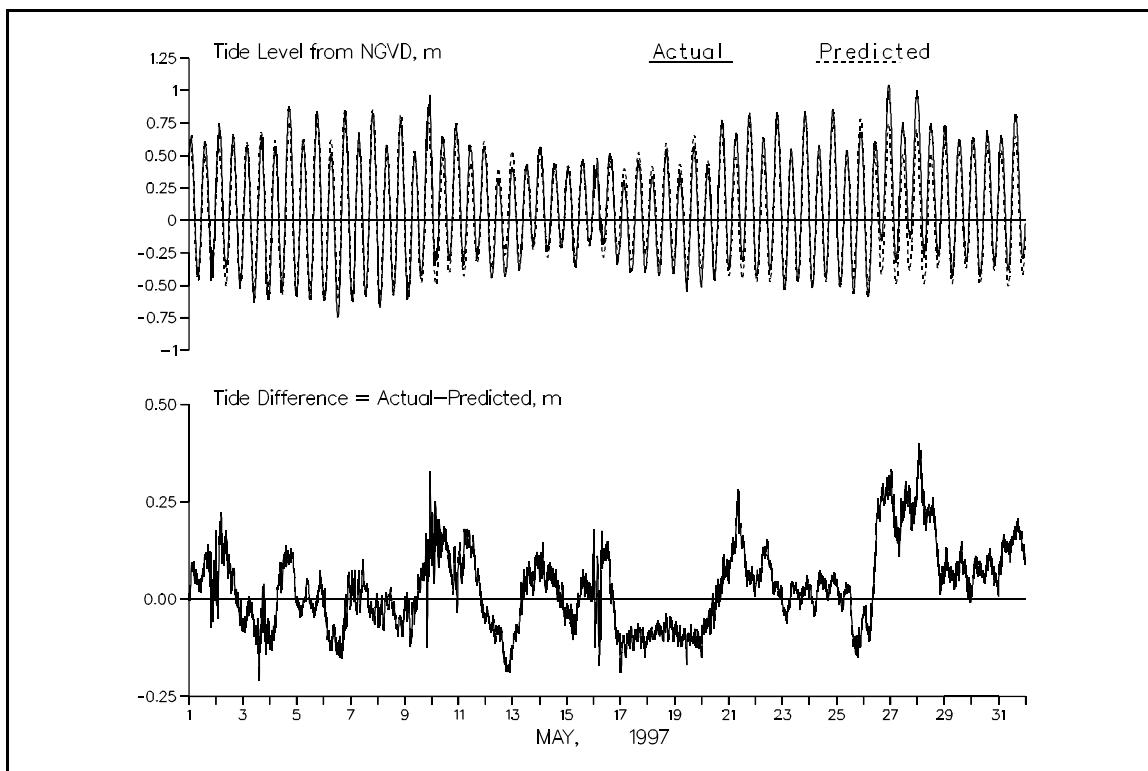


Figure 6. Water Level Variation

Table 8
Water Levels, m NGVD

MAY 1997 Tide Levels																		
Day	High			Low			Mean Range			High			Low			Mean Range		
	Time	m	Day	Time	m	Day	m	m	Day	Time	m	Day	Time	m	Day	m	m	
1	0218	0.65	1	0836	-0.43	1	0.10	1.09	16	1406	0.51	16	2118	-0.34	1	0.11	0.85	
1	1418	0.61	1	2006	-0.47	1	0.13	1.08	17	0312	0.31	17	0836	-0.40	1	-0.06	0.71	
2	0300	0.74	2	0900	-0.36	2	0.16	1.10	17	1600	0.46	17	2148	-0.41	2	0.03	0.87	
2	1524	0.66	2	2142	-0.53	2	0.08	1.19	18	0354	0.34	18	1006	-0.43	2	-0.04	0.77	
3	0400	0.58	3	1018	-0.64	3	-0.01	1.21	18	1630	0.55	18	2236	-0.41	3	0.06	0.96	
3	1636	0.65	3	2236	-0.61	3	0.00	1.26	19	0454	0.37	19	1048	-0.55	3	-0.06	0.91	
4	0500	0.57	4	1106	-0.55	4	0.04	1.12	19	1706	0.57	19	2354	-0.52	4	0.04	1.09	
4	1718	0.88	4	2354	-0.59	4	0.16	1.47	20	0524	0.41	20	1200	-0.46	4	0.00	0.87	
5	0554	0.62	5	1136	-0.61	5	0.01	1.23	20	1800	0.77	21	0006	-0.38	5	0.20	1.15	
5	1812	0.84	6	0036	-0.62	6	0.10	1.46	21	0648	0.68	21	1224	-0.31	5	0.19	0.99	
6	0636	0.51	6	1230	-0.75	6	-0.10	1.27	21	1842	0.83	22	0112	-0.43	6	0.19	1.25	
6	1854	0.85	7	0112	-0.61	7	0.10	1.46	22	0700	0.64	22	1242	-0.39	6	0.12	1.02	
7	0724	0.68	7	1312	-0.57	7	0.03	1.25	22	1918	0.83	23	0148	-0.54	7	0.14	1.37	
7	1954	0.82	8	0206	-0.67	8	0.08	1.49	23	0742	0.55	23	1336	-0.47	7	0.04	1.03	
8	0800	0.58	8	1400	-0.58	8	0.00	1.16	23	2006	0.84	24	0230	-0.52	8	0.15	1.36	
8	2018	0.77	9	0236	-0.61	9	0.07	1.38	24	0830	0.58	24	1436	-0.44	8	0.07	1.02	
9	0906	0.53	9	1506	-0.43	9	0.05	0.96	24	2048	0.86	25	0254	-0.51	9	0.16	1.37	
9	2236	0.97	10	0230	-0.35	10	0.25	1.32	25	0924	0.54	25	1518	-0.57	9	0.01	1.11	
10	0954	0.65	10	1512	-0.31	10	0.17	0.96	25	2124	0.68	26	0400	-0.59	10	0.05	1.27	
10	2148	0.75	11	0406	-0.35	11	0.21	1.10	26	1036	0.61	26	1554	-0.16	10	0.23	0.77	
11	0948	0.58	11	1618	-0.29	11	0.15	0.87	26	2300	1.04	27	0500	-0.33	11	0.36	1.37	
11	2248	0.57	12	0518	-0.44	12	0.06	1.02	27	1100	0.75	27	1748	-0.14	11	0.30	0.90	
12	1136	0.33	12	1724	-0.44	12	-0.05	0.76	27	2336	1.00	28	0600	-0.29	12	0.37	1.29	
12	2354	0.41	13	0548	-0.39	13	0.01	0.80	28	1154	0.75	28	1806	-0.27	12	0.25	1.02	
13	1306	0.44	13	1830	-0.21	13	0.13	0.64	29	0024	0.74	29	0642	-0.44	13	0.15	1.17	
14	0024	0.57	14	0654	-0.24	14	0.17	0.81	29	1312	0.62	29	1948	-0.32	14	0.17	0.94	
14	1324	0.44	14	1906	-0.22	14	0.12	0.66	30	0130	0.64	30	0748	-0.43	14	0.12	1.07	
15	0100	0.40	15	0806	-0.36	15	0.04	0.77	30	1400	0.69	30	2018	-0.35	15	0.18	1.04	
15	1448	0.48	15	2030	-0.19	15	0.13	0.67	31	0236	0.65	31	0848	-0.39	15	0.15	1.04	
16	0324	0.48	16	0806	-0.19	16	0.11	0.67	31	1530	0.82	31	2148	-0.30	16	0.26	1.12	

Bathymetry

7

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using a Trimble 4000 SSE GPS for positioning, in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 7 shows the last survey in April and the survey(s) in May on profile line 188, located 517 m south of the pier.

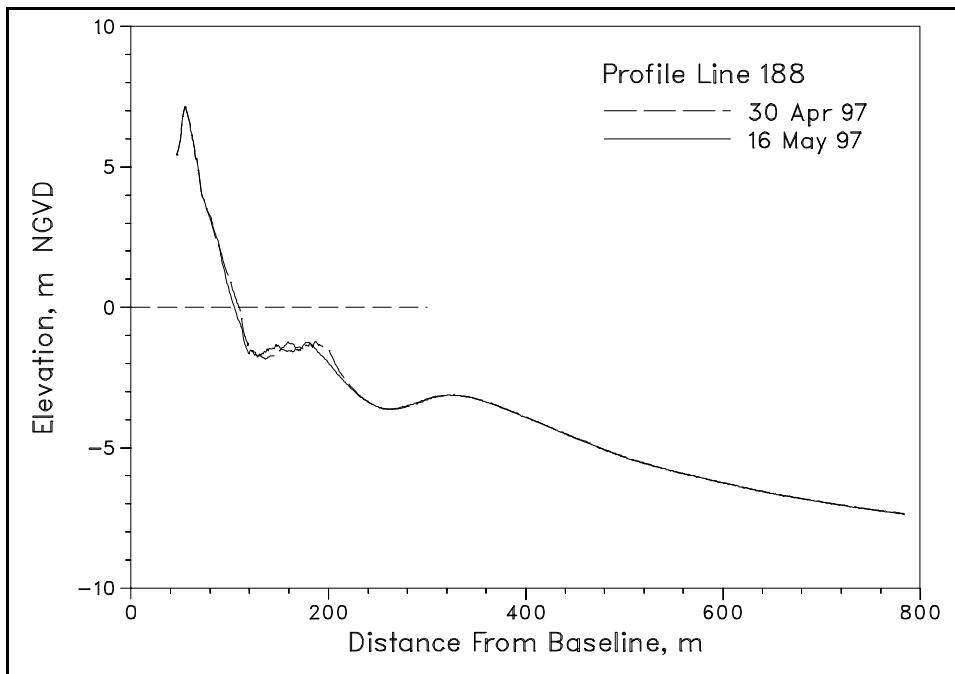


Figure 7. Monthly CRAB Profiles on Profile Line 188.

The profile envelope (Figure 8) reflects the maximum changes that occurred on the profile during 1997. Cross-hatched areas indicate changes to the annual envelope which occurred in May.

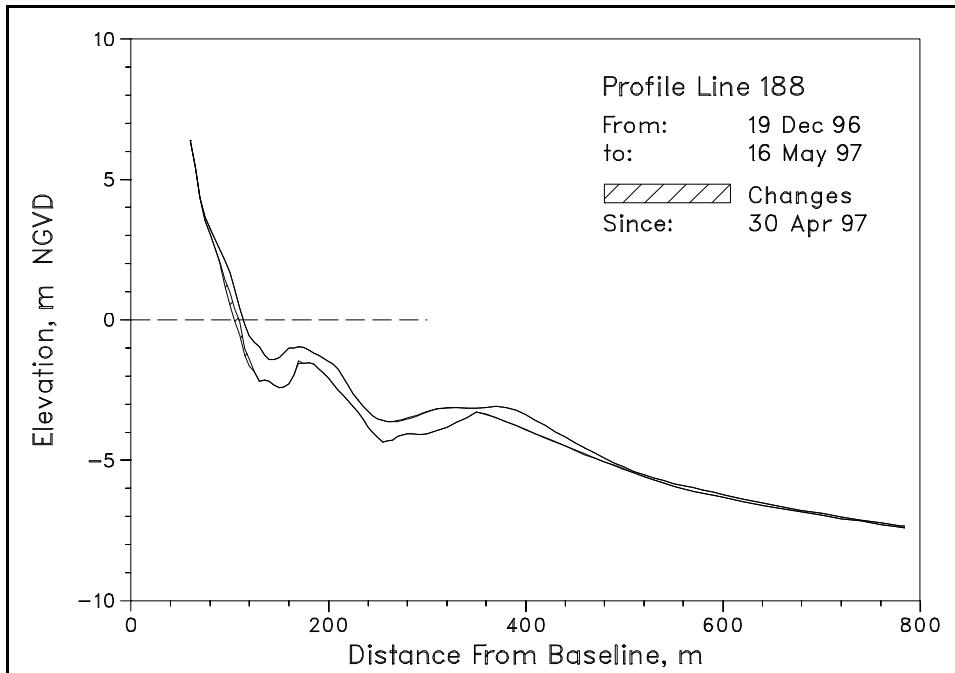
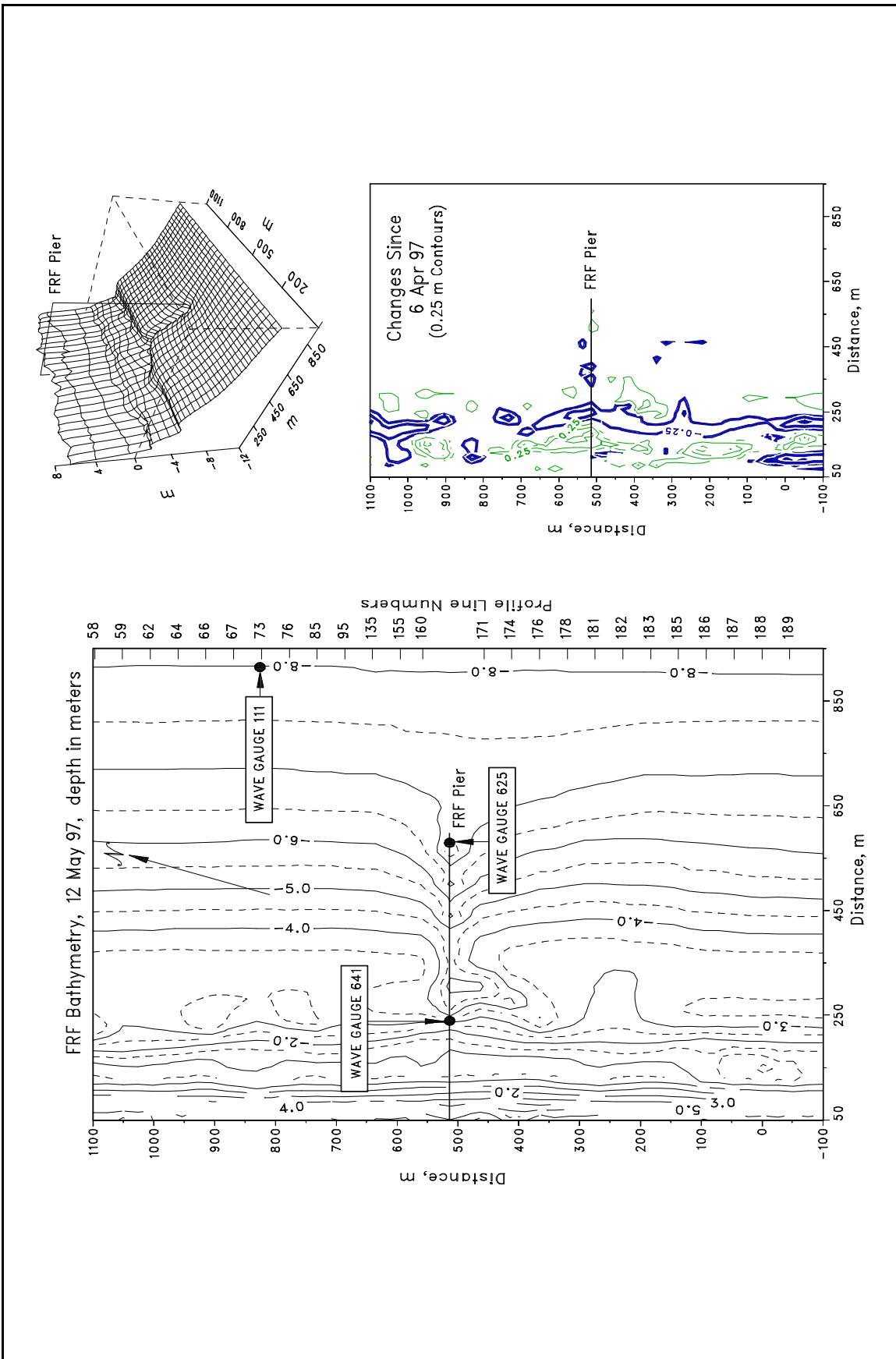


Figure 8. Profile Envelope - Profile Line 188.

B. Bathymetry. Figure 9 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 12 May. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.



Special Events

8

A. Storm Data Collection. The following list identifies times when the wave height H_{mo} at the seaward end of the pier exceeded 2 m.

	<u>Start</u>	<u>End</u>
	27 May (0916)	28 May (0542)

B. Storm Synopsis.

Northeasterly winds (NE), associated with a cold front, reached 13 m/s at 1600 EST on 27 May. The maximum H_{mo} , at gauge 630, reached 2.66 m ($T_p=10.0$ s) at 1900 EST on 27 May. There was 5 mm of precipitation.